NEET ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS

CLASS :- 11th **PAPER CODE :- CWT-5**

CHAPTER :- CIRCULAR MOTION

ANSWER KEY

1.	(C)	**2.**	(C)	**3.**	(A)	**4.**	(C)	**5.**	(A)	**6.**	(D)	**7.**	(A)
8.	(C)	**9.**	(A)	**10.**	(D)	**11.**	(B)	**12.**	(C)	**13.**	(C)	**14.**	(C)
15.	(C)	**16.**	(B)	**17.**	(C)	**18.**	(A)	**19.**	(C)	**20.**	(A)	**21.**	(B)
22.	(B)	**23.**	(C)	**24.**	(B)	**25.**	(A)	**26.**	(C)	**27.**	(C)	**28.**	(B)
29.	(D)	**30.**	(A)	**31.**	(D)	**32.**	(D)	**33.**	(D)	**34.**	(B)	**35.**	(D)
36.	(A)	**37.**	(B)	**38.**	(C)	**39.**	(A)	**40.**	(C)	**41.**	(D)	**42.**	(B)
43.	(D)	**44.**	(D)	**45.**	(A)	**46.**	(C)	**47.**	(A)	**48.**	(D)	**49.**	(B)
50.	(A)												

SOLUTIONS

SECTION-A

1. (C)

Sol. Speed $v_1 = \frac{2\pi r_1}{t}$

$v_2 = \frac{2\pi r_2}{t}$

$\omega_1 = \frac{v_1}{r_1} = \frac{2\pi}{t} \Rightarrow \quad \omega_2 = \frac{v_2}{r_2} = \frac{2\pi}{t}$

$\omega_1 = \omega_2 \quad \Rightarrow \frac{\omega_1}{\omega_2} = \frac{1}{1}$ **Ans.**

2. (C)

Sol. $\omega = 80$ rad/sec, $t = 5$ sec, $\omega_0 = 0$

$\theta = ?$

If α constant, then

$\theta = \left(\frac{\omega + \omega_0}{2}\right) t = \left(\frac{80+0}{2}\right) 5 = 200$ rad

Ans.

3. (A)

4. (C)

5. (A)

Sol. Use $= w = \frac{2\pi}{T}$

6. (D)

Sol. Minute hand of a clock rotates through an angle of 2π in 60 minutes i. e. 3600 sec

$\therefore$ Angular velocity

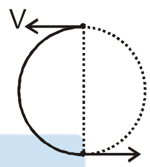
$\omega = \frac{2\pi}{3600} = \frac{\pi}{1800}$ rad/s

7. (A)

Sol. $\Delta\vec{V} = \vec{V}_1 - \vec{V}_2$

$= \vec{V} - (-\vec{V})$

$= 2\vec{V}$

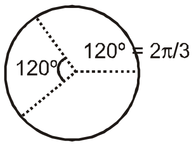


$|\Delta\vec{V}| = 2V$

$= 2 \times 100$ km/hr $= 200$ km/hr. Ans

8. (C)

Sol. $\omega_{arg} = \langle\omega\rangle = \frac{\text{total}\,\theta}{\text{total time}}$



$= \frac{2\pi/3 + 2\pi/3}{2+1} = \frac{4\pi}{9}$ rad/sec.

9. (A)

Sol. $\theta = \frac{1}{2}\alpha t^2$ as $\omega_0 = 0$

$= \frac{1}{2} \times 4 \times 4^2 = 32$ rad

$\omega = \alpha.t = 4 \times 4 = 16$ rad/sec.

10. (D)

Sol. $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\omega = \omega_0 + \alpha t = 1 + 1.5 \times 2 = 4$ rad/sec.

11. (B)

Sol. For a particle moving in a circle with constant angular speed, velocity vector is always tangent to the circle and the acceleration vector always points towards the centre of circle or is always point towards the centre of circle or is always along radius of the circle. Since, tangential vector is perpendicular to radial vector, therefore, velocity vector will be perpendicular to the acceleration vector. But in no case acceleration vector is tangent to the circle

12. (C)

Sol. When a force of constant magnitude acts on velocity of particle perpendicularly, then there is no change in the kinetic energy of particle. Hence, kinetic energy remains constant.

13. (C)

Sol. (C) Using relation $\theta = \omega_0 t + \frac{1}{2}at^2$

$\theta_1 = \frac{1}{2}(\alpha)(2)^2 = 2\alpha$ ...(i) (As $\omega_0 = 0, t = 2\,\text{sec}$)

Now using same equation for t = 4 sec, $\omega_0 = 0$

$\theta_1 + \theta_2 = \frac{1}{2}\alpha(4)^2 = 8\alpha$ ...(ii)

From (i) and (ii), $\theta_1 = 2\alpha$ and $\theta_2 = 6\alpha$ $\therefore$ $\frac{\theta_2}{\theta_1} = 3$

14. (C)

Sol. (C) $\omega = \frac{d\theta}{dt} = \frac{d}{dt}(2t^3 + 0.5) = 6t^2$

at t =2 s, $\omega = 6 \times (2)^2 = 24\,\text{rad/s}$

15. (C)

Sol. For circular motion of particle a_r not equal to zero, a_t may or may not be zero.

16. (B)

Sol. Time period

$= \frac{\text{No. of revolutions}}{\text{time}} = \frac{25}{14}$ = 1.79 sec

Now angular speed

$\omega = \frac{2\pi}{T} = \frac{2 \times 3.14}{1.79}$ = 3.51 rad/sec

Now magnitude of acceleration is given by

$a = \omega^2 l = (3.51)^2 \times 80$

= 985.6 cm/sec^2

= 996 cm/sec^2

17. (C)

Sol. $F_{C1} = F_{C2}$ $\Rightarrow$ $\frac{mv_1^2}{r_1} = \frac{mv_2^2}{r_2}$

$\frac{v_1}{v_2} = \sqrt{\frac{r_1}{r_2}} = \frac{1}{\sqrt{2}}$ **Ans.**

18. (A)

Sol. (A) Max. tension that string can bear = 3.7 *kgwt* = 37*N*

Tension at lowest point of vertical loop $= mg + m\omega^2 r$

$= 0.5 \times 10 + 0.5 \times \omega^2 \times 4 = 5 + 2\omega^2$

$\therefore$ 37 = 5 + 2ω^2 $\Rightarrow$ ω = 4 rad/s.

19. (C)

Sol. (C) In uniform circular motion tangential acceleration remains zero but magnitude of radial acceleration remains constant.

20. (A)

Sol. For just slip $\Rightarrow$ $\mu mg = m\omega^2 r$

here ω is double then radius is 1/4th

r´ = 1 cm **Ans.**

21. (B)

(A) 2 (B*) 8 (C) 0.2 (D) 0.8

Sol. $T = \frac{mv^2}{r} = \frac{0.5 \times (4)^2}{1}$ = 8N

22. (B)

Sol. Here : Mass of car m = 500 kg

Radius r = 50 m

Speed of car υ = 36 km/hr

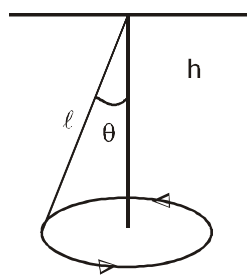
$= \frac{36 \times 5}{18}$ = 10 m/s

The centripetal force is given by

$F = \frac{m\upsilon^2}{r} = \frac{500 \times (10)^2}{50}$ = 1000 N

23. (C)

Sol. $h = \ell \cos\theta$ $T = 2\pi\sqrt{\frac{\ell\cos\theta}{g}}$



24. (B)

25. (A)

Sol. It can be observed that component of acceleration perpendicular to velocity is

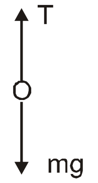
$a_c = 4\ m/s^2$

$\therefore$ radius $= \dfrac{v^2}{a_c} = \dfrac{(2)^2}{4} = 1$ metre.

26. (C)

Sol. at lowest point

$T - mg = \dfrac{mv^2}{r}$



$T = mg + \dfrac{mv^2}{r}$

27. (C)

Sol. $T - mg \cos\theta = \dfrac{mv^2}{r}$ ....(A)

(from centripetal force
from energy conservation.

$\dfrac{1}{2}mu^2\ \dfrac{1}{2} = mv^2 + mgr\,(1 - \cos\theta)$

(here u is speed at lowest point)

from (A) and (B)

$T = \dfrac{mu^2}{r} + 3mg\cos\theta - 2mg$

for $\theta = 30^\circ\ \&\ 60^\circ \Rightarrow T_1 > T_2$

Ans.

28. (B)

29. (D)

Sol. $mrw^2 = /mg$, $w = \sqrt{\dfrac{g}{r}}$, $T = 2\pi\sqrt{\dfrac{r}{g}} =$

$2\pi\sqrt{\dfrac{4}{10}} = 2 \times 2\sqrt{\dfrac{\pi^2}{10}} = 4$ Sec

30. (A)

Sol. When a string fixed with a nail, moves along a vertical circle, then the minimum horizontal velocity at the lowest point of circle is given by

$\upsilon = \sqrt{5rg}$

$= \sqrt{5 \times 0.25 \times 9.8}$

$= 3.5$ m/s

31. (D)

Sol. $mgh = \dfrac{1}{2}mv^2$ $2gh = v^2$

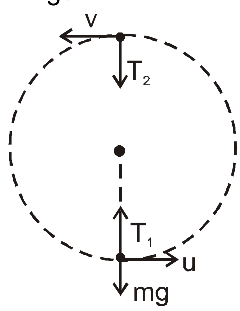
$V^2 > 5\ gR$ $\quad$ $2gh > 5\ Rh$

$h > \dfrac{5}{2}R$

32. (D)

Sol. $\dfrac{T_1}{T_2} = \dfrac{\dfrac{mu^2}{\ell} + mg}{\dfrac{mv^2}{\ell} - mg}$ $\quad$ $\dfrac{1}{2}mu^2 - \dfrac{1}{2}mv^2 =$

$2\ mg\ell$



$\Rightarrow u^2 - v^2 = 4g\ell$

$u^2 = 4g\ell + v^2$

$4\ v^2 - 4g\ell = u^2 + g\ell$

$4\ v^2 - 4g\ell = 4\ g\ell + v^2 + g\ell$

$3v^2 = 9\ g\ell$ $\quad$ $v = \sqrt{2g\ell} = \sqrt{3 \times 10\dfrac{10}{3}} =$

10 m/s

33. (D)

Sol. For circular motion in vertical plane normal reaction is minimum at highest point and it is zero, minimum speed of motorbike is -

$mg = \dfrac{mv^2}{R} \Rightarrow v = \sqrt{gR}$

Ans.

34. (B)

Sol. Here required centripetal force provide by friction force. Due to lack of sufficient centripetal force car thrown out of the road in taking a turn.

35. (D)

Sol. (D) For critical condition at the highest point

$\omega = \sqrt{g/R}$

$\Rightarrow T = \dfrac{2\pi}{\omega} = 2\pi\sqrt{R/g} = 2 \times 3.14\sqrt{4/9.8} = 4$ sec.

SECTION-B

36. (A)

Sol. Maximum retardation $a = \mu g$

For apply brakes sharply minimum distance require to stop.

$0 = v^2 - 2\mu gs$

$\Rightarrow \quad s = \dfrac{v^2}{2\mu g}$

For taking turn minimum radius is

$\mu g = \dfrac{v^2}{r}, \quad \Rightarrow \quad r = \dfrac{v^2}{\mu g},$

here r is twice of s
so apply brakes sharply is safe for driver.

37. (B)

Sol. $F_c = mk^2 rt^2$

$a_c = k^2rt^2 = \dfrac{v^2}{r} \quad \Rightarrow \quad v = krt$

$a_t = \dfrac{dv}{dt} = kr$

$F_t = mkr \Rightarrow \quad P = \vec{F} . \vec{v} \quad (\because \vec{F}_C . \vec{v} = 0)$

$P = \vec{F}_t . \vec{v} = mkr \times krt = mk^2r^2t$

Ans.

38. (C)

39. (A)

Sol. $KE = \dfrac{1}{2}mv^2 \qquad \because F = \dfrac{mv^2}{R}$

$\because \; F = \dfrac{K}{r^2} = \dfrac{mv^2}{r^2} \qquad \dfrac{1}{2}mv^2 = \dfrac{k}{2r}$

Potential energy $U = \int Fdr$

$= \int\left(-\dfrac{k}{r^2}\right)dr = \dfrac{k}{r}$

Total energy = U +K

$= -\dfrac{K}{r} + \dfrac{K}{2r} = -\dfrac{K}{2r}$

$E \,\alpha\, \dfrac{1}{-2r}$

40. (C)

Sol. The coin will revolve with the record, if Force of friction $\geq$ Centrifugal force

$\mu mg \geq mr\omega^2$

or $\qquad \dfrac{\mu g}{\omega^2} \geq r$

$\mu mg \geq m\omega^2 r$

$\dfrac{\mu g}{\omega^2} \geq r$

41. (D)

Sol. Centripetal acceleration

$a_C = \omega^2 r = \left(\dfrac{2\pi}{T}\right)^2 r = \left(\dfrac{2\pi}{0.2\pi}\right)^2 \times 5 \times 10^{-2} = 5 \text{ m/s}^2$

tangential acceleration is zero as constant speed so

acceleration = $\sqrt{a_c^2 + a_t^2} = 5 \text{ m/s}^2$

42. (B)

Sol. For banking $\tan\theta = \dfrac{V^2}{Rg}$

$\tan 45 = \dfrac{V^2}{90 \times 10} = 1 \qquad V = 30 \text{ m/s}$

43. (D)

Ans. (D)

Sol. For smooth driving maximum speed of car v then

$\dfrac{mv^2}{R} = \mu_s mg$

$v = \sqrt{\mu_s Rg}$

44. (D)

Ans. **(D)**

Sol. In vertical circular motion, tension in wire will be maximum at lower most point, so the wire is most likely to break at lower most point.

45. (A)

Ans. **(A)**

Sol. Time period (T) = $\dfrac{2\pi}{\omega}$

ω = angular speed

$T_1 = T_2$ (given)

$\dfrac{2\pi}{\omega_1} = \dfrac{2\pi}{\omega_2}$

$\omega_1 = \omega_2$

$\omega_1 : \omega_2 = 1 : 1$

46. (C)

Sol. They have same ω.

centripetal acceleration = $\omega^2 r$

$\dfrac{a_1}{a_2} = \dfrac{\omega^2 r_1}{\omega^2 r_2} = \dfrac{r_1}{r_2}$

47. (A)

Sol. We know that $W = Fs\cos\theta$

in the circular motion if $\theta = 90^o$ then $W = 0$

48. (D)

Sol. When the milk is churned centrifugal force acts on it outward and due to which cream in milk is separated from it.

49. (B)

50. (A)

Sol. (a) $\vec{a} = \vec{\omega} \times (\vec{\omega} \times \vec{R}) \Rightarrow \omega^2 R = \frac{v^2 R}{R^2}$

$= \frac{v^2}{R}$ and $\vec{a}_2 = 0 \therefore (a) \rightarrow p,q$

(b) $\vec{a} = \vec{\alpha} \times \vec{R} \Rightarrow$ since total acceleration is only

$a = \alpha R, a_R = 0$, which implies v = 0 and

$a_R = \frac{v^2}{R} = 0$ and $a = \frac{dv}{dt}$

$\therefore (b) \rightarrow q,s$

(c) $|\vec{a}| = \sqrt{2}\,|\vec{a}_R| \Rightarrow \vec{a}_r$ and $\vec{a}_R$ are equal and perpendicular

$\therefore (c) \rightarrow q,r$

(d) $\vec{a} = (\vec{\omega} \times \vec{v}) = \vec{a}_R \Rightarrow \vec{a}_R = \frac{v^2}{R}$. Same as (a)

$\therefore (d) \rightarrow p,q$